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Portland District

Coastal Infrastructure Management

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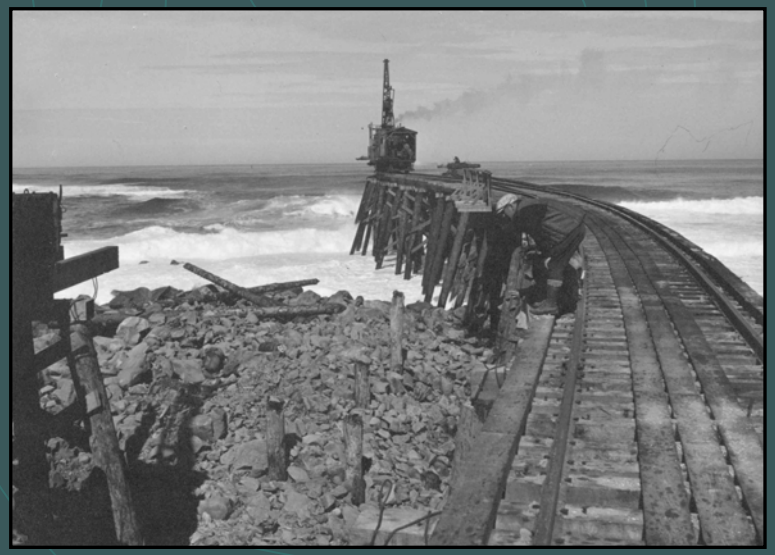
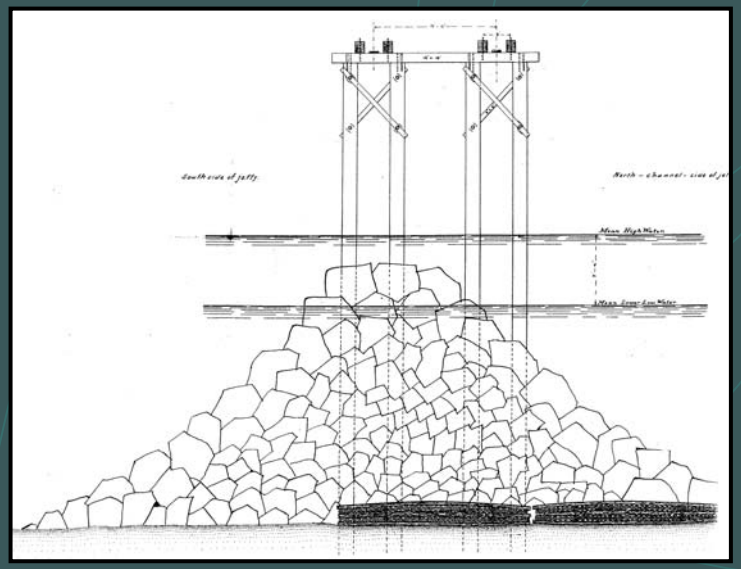
Presentation Outline

- Key risk management questions
- Portland District's first tier approach
- Areas needing improvement
- Creative tools to address challenges





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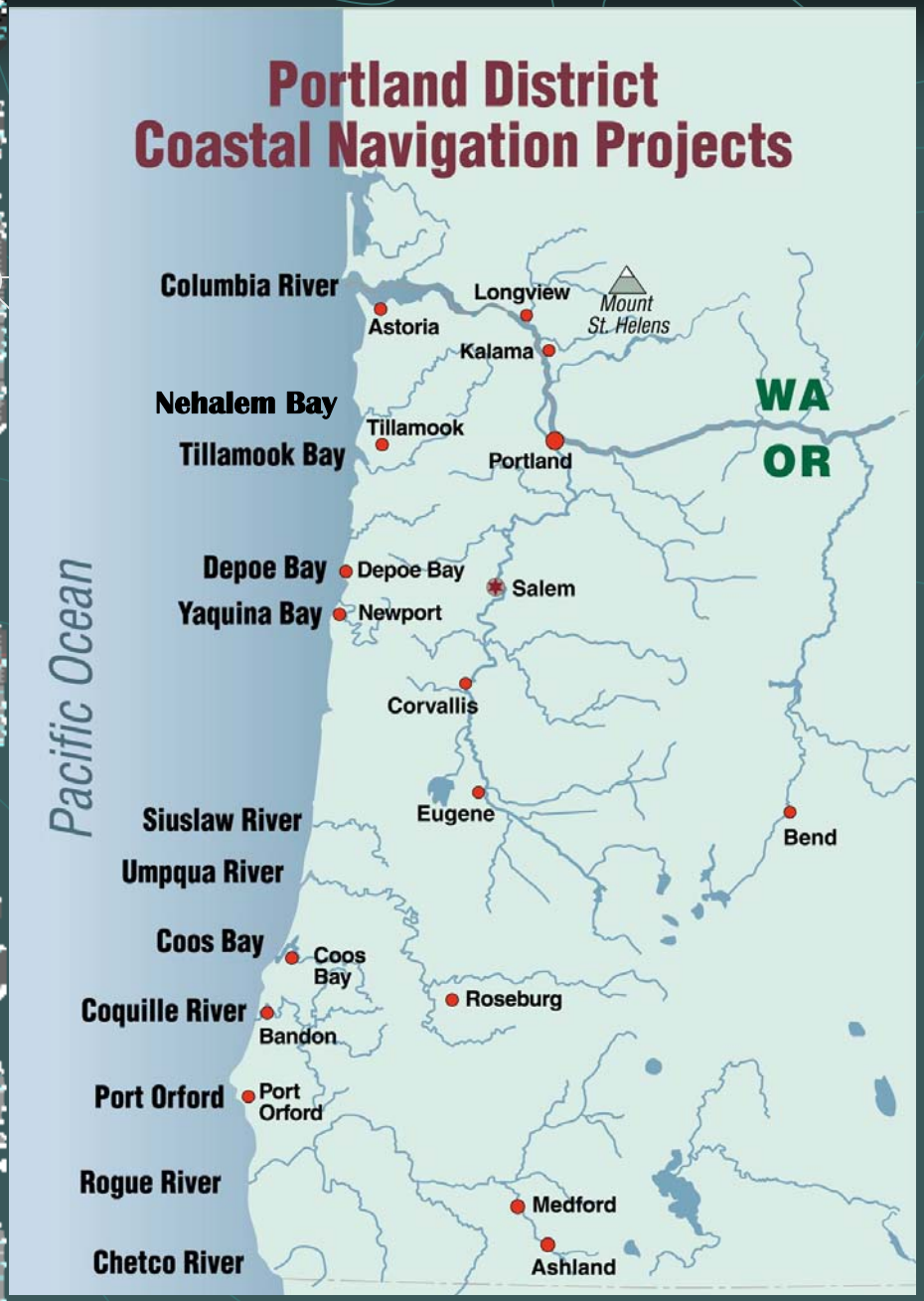
Key Risk Management Questions

- How well do we understand the forcing environment? Can our approach incorporate increasing trends or changes?
- Do our design and reliability procedures adequately capture the potential range of the controlling processes?
- Do we understand the project function and the level of risk associated with non-action or non-performance?
- How are we prioritizing infrastructure work and what tools are we using to evaluate and communicate risk?
- Are we fully utilizing all available tools to optimize repairs and minimize costs? Are we planning for long-term sustainability?



11 Jettied Entrances

(Including Mouth of Columbia River)

30 Miles – Rubblemound

Armor Size – 10 to 50 ton

Channel depths – 8 to 55 ft

Construction / Repair - $2.0 Billion

Age of Infrastructure: 30 to 130 yrs

Asset Management Program Goal Avoid:

- Loss of federal infrastructure investment
- Increased project costs
- Impacts to project function
- Loss of life
- Environmental impacts

3 Tiers of Investment or Budget Request

Delineated by (1) Degree of investment and (2) Level of risk assessment

Routine Inspection

Data Collection

Evaluation Study

Adequate program support and flexibility of tier one investigations are essential to facilitate district level execution of coastal navigation infrastructure management.

Increment 1 Funding Base Level

Low Level Risk Assessment, No Economics

Medium Level Risk Assessment, Basic Economics

High Level Risk Assessment, High Level Economic Justification

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Minimum First Tier Requirements

- Recognize that majority of infrastructure system is 100+ years old. (with encompassing 100 year old changes to the system)
- Collect adequate base level information to identify and prioritize higher level investigation and actions.
- Conduct sufficient investigation to identify safety concerns, local Port and Coast Guard needs.
- Develop communication tools of sufficient detail for upward reporting and justification.
- Recommend preventative and interim repairs judicially to prevent rapid loss of function and expensive emergency actions.

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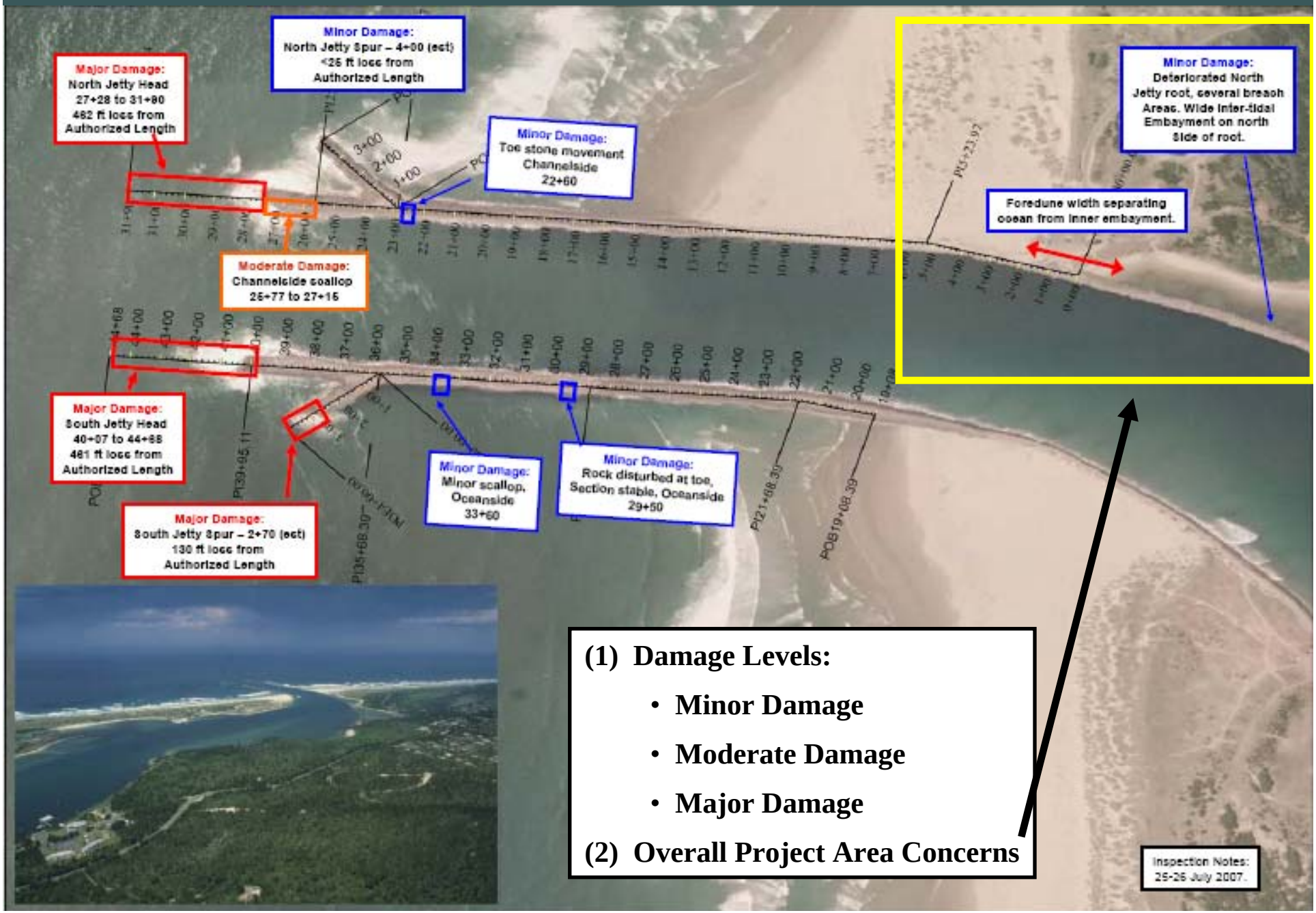
First Tier Utilizes Two Part Approach

- Routine Inspections
  - Annual ground inspections and report
  - Update Coastal Projects Matrix and Critical Infrastructure Spreadsheet
- Evaluation Study / Preliminary Risk Assessment
  - Conducted as identified by routine inspections
  - Structure and hydrographic Surveys
  - Engineering assessment
  - Budget and project recommendations

Annual Ground Inspections Identify and Track Damage Zones and Potential Problem Areas



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Key Elements of First Tier Program

- Project Assessment:
  - Original and Current Design Criteria
  - Project feature evolution (structure, channel, shoreline, shoals)
  - Forcing environment (waves, currents, foundation, power)
  - Project function and economic importance
- Communication / Coordination:
  - Identify rates of change and levels of risk
  - Be able to identify alternative types and levels of action
  - Be able to project no action impacts to structures and function

Investigate Timing and Sequence of Original Construction

- North Jetty (length = 4090 ft)
  Sta. –63+75 to –22+85

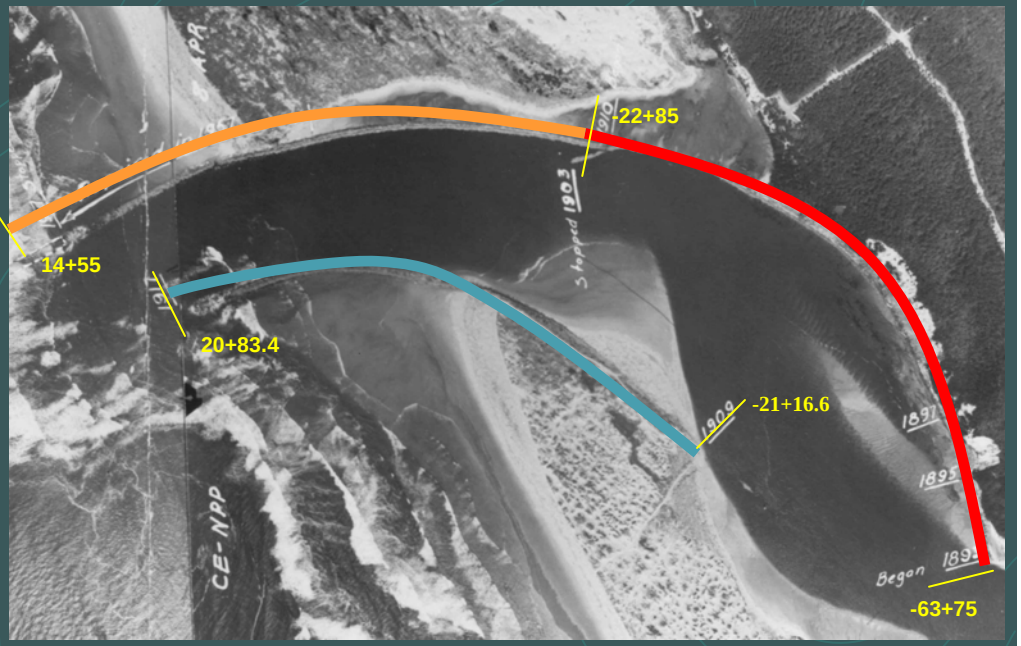
  1893 - 1901

- North Jetty (additional 3740 ft)
  Sta. –22+85 to 14+55

  1912 - 1917

- South Jetty (length = 4200 ft)
  Sta. –21+16.6 to 20+83.4

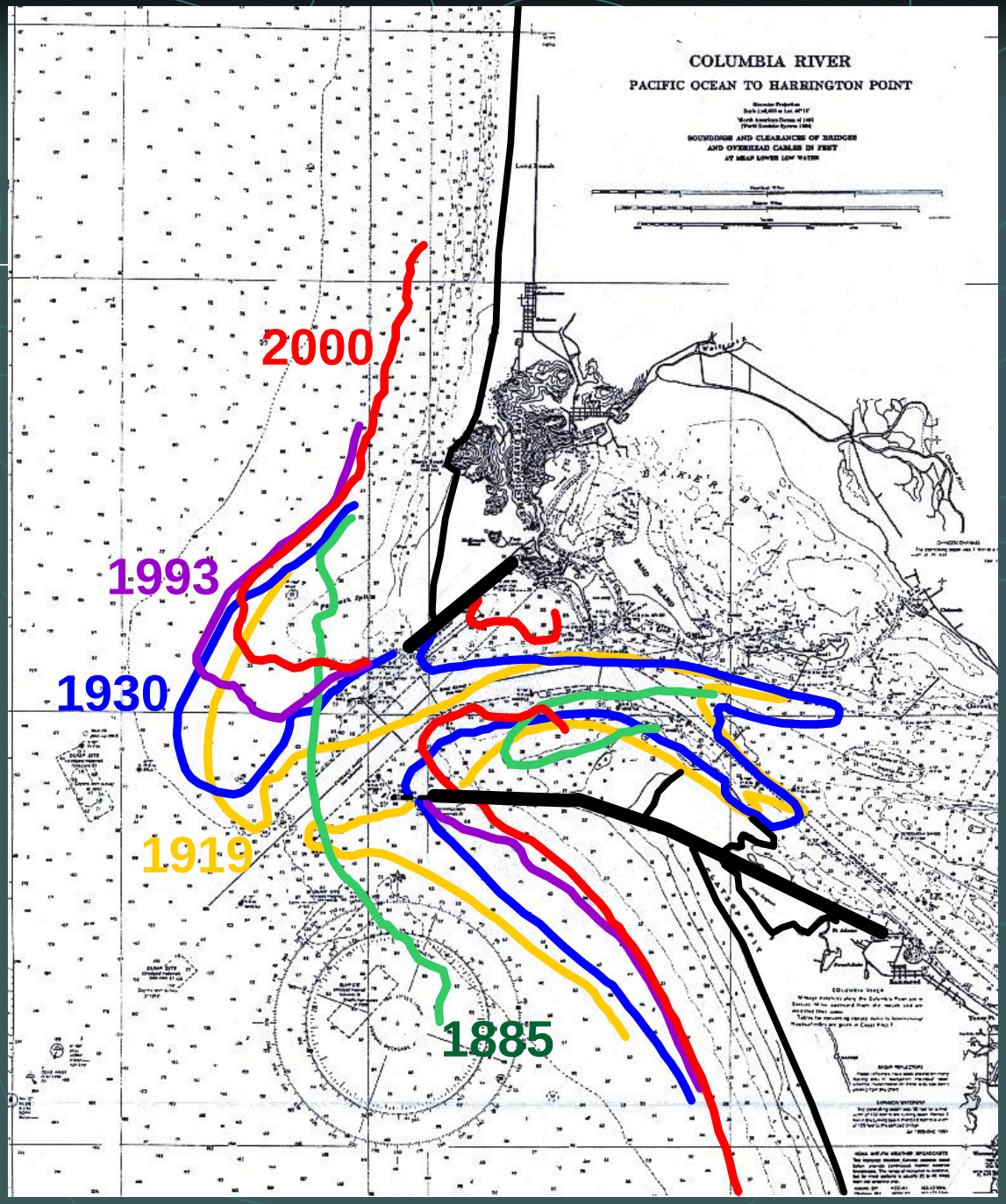
  1916 - 1917



Sequence of construction may have influenced accretion zones as well as structure exposure.

Understand Evolution of Design Criteria and Structure Characteristics

Design Parameter	1966	1978	1988	2001
Wave Height (ft)				
Above 0 ft m.l.l.w.	21.8	20.2	28.0	33.0
Below 0 ft m.l.l.w.	21.8	20.2	22.0	31.0
Water Level (ft, m.l.l.w.)	+10	+8	+10	+13
Stability Coefficient				
Above 0 ft m.l.l.w.	7.1	8.1	7.1	8.0
Below 0 ft m.l.l.w.	7.1	8.1	4.6	4.0
Stone Density (pcf)				
Main Body	167	167	167	165
Toe Berm				178
Structure Sideslope (V:H)				
Above 0 ft m.l.l.w.	1:2	1:2	1:2	1:2.5
Below 0 ft m.l.l.w.	1:1.5	1:1.5	1:1.5	1:4.0
Crest Elevation (ft,MLLW)	+20	+20	+20	+20
Crest Width (ft)	30	30	30	40
Armor Stone Size (tons)				
Main Body	22.0	18.9	31.1	38.0
Toe Berm	22.0	18.9	31.1	29.0



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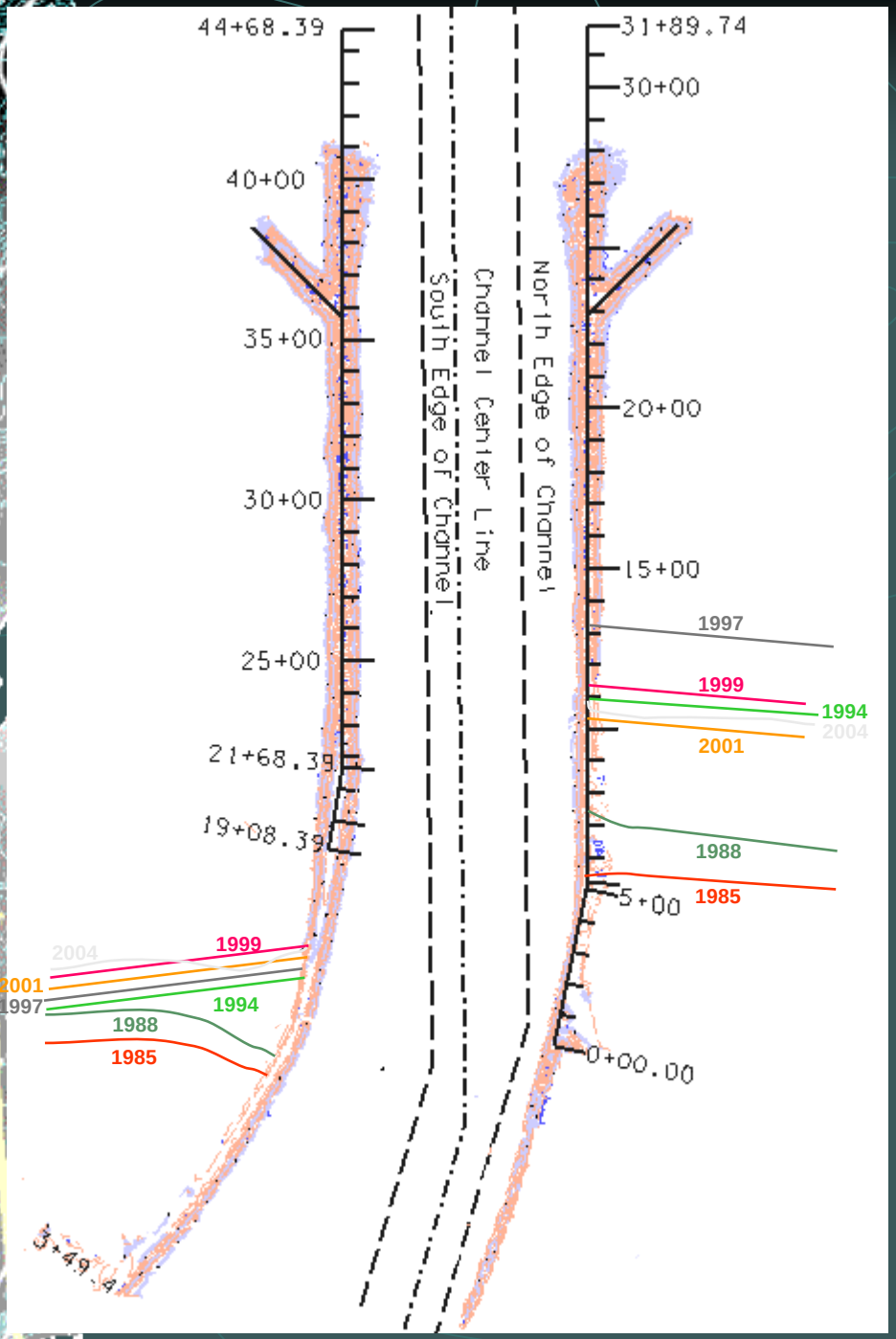
Track surrounding morphology changes (including rate of change)

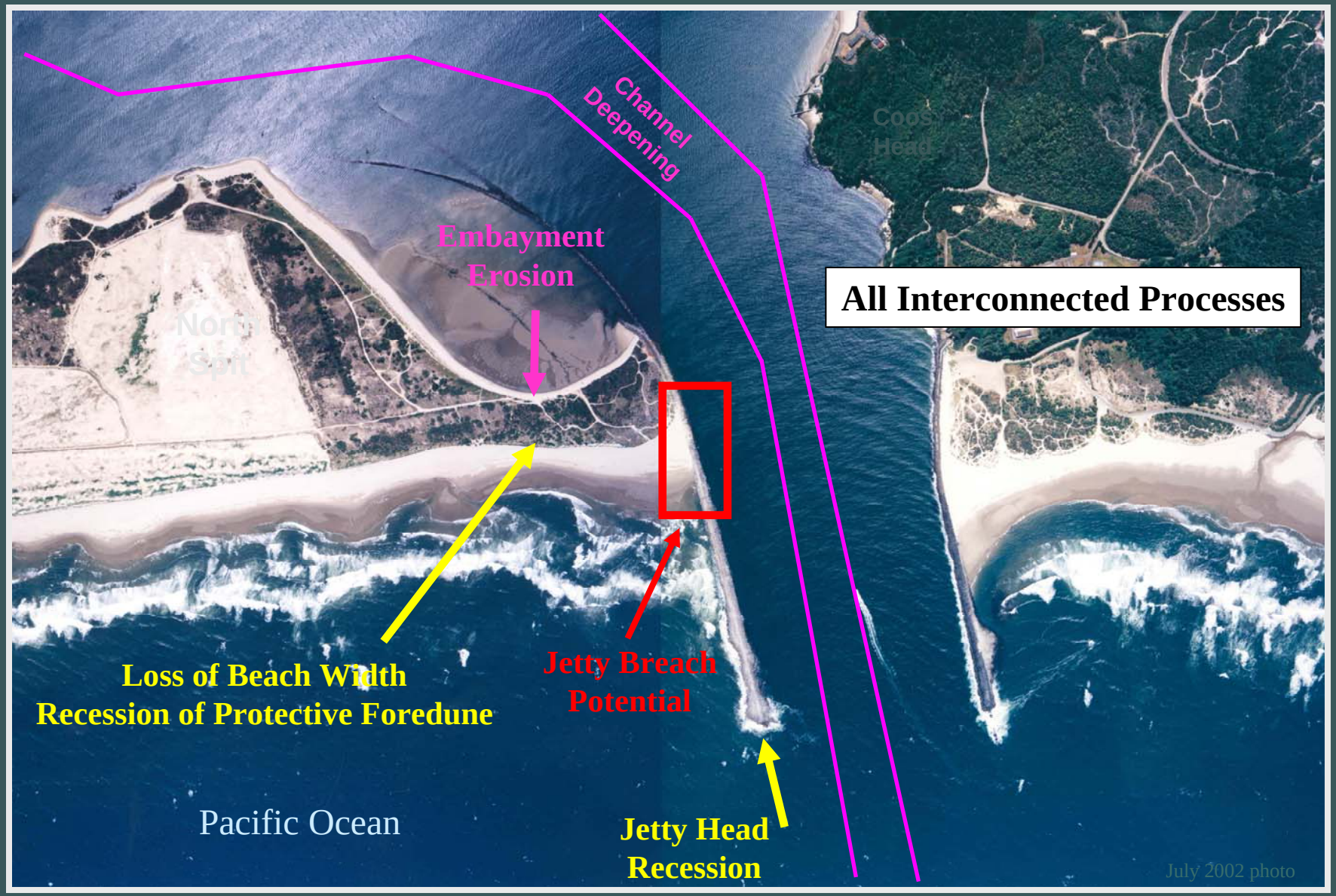
Map of –40 ft contours around MCR @ 5 time periods

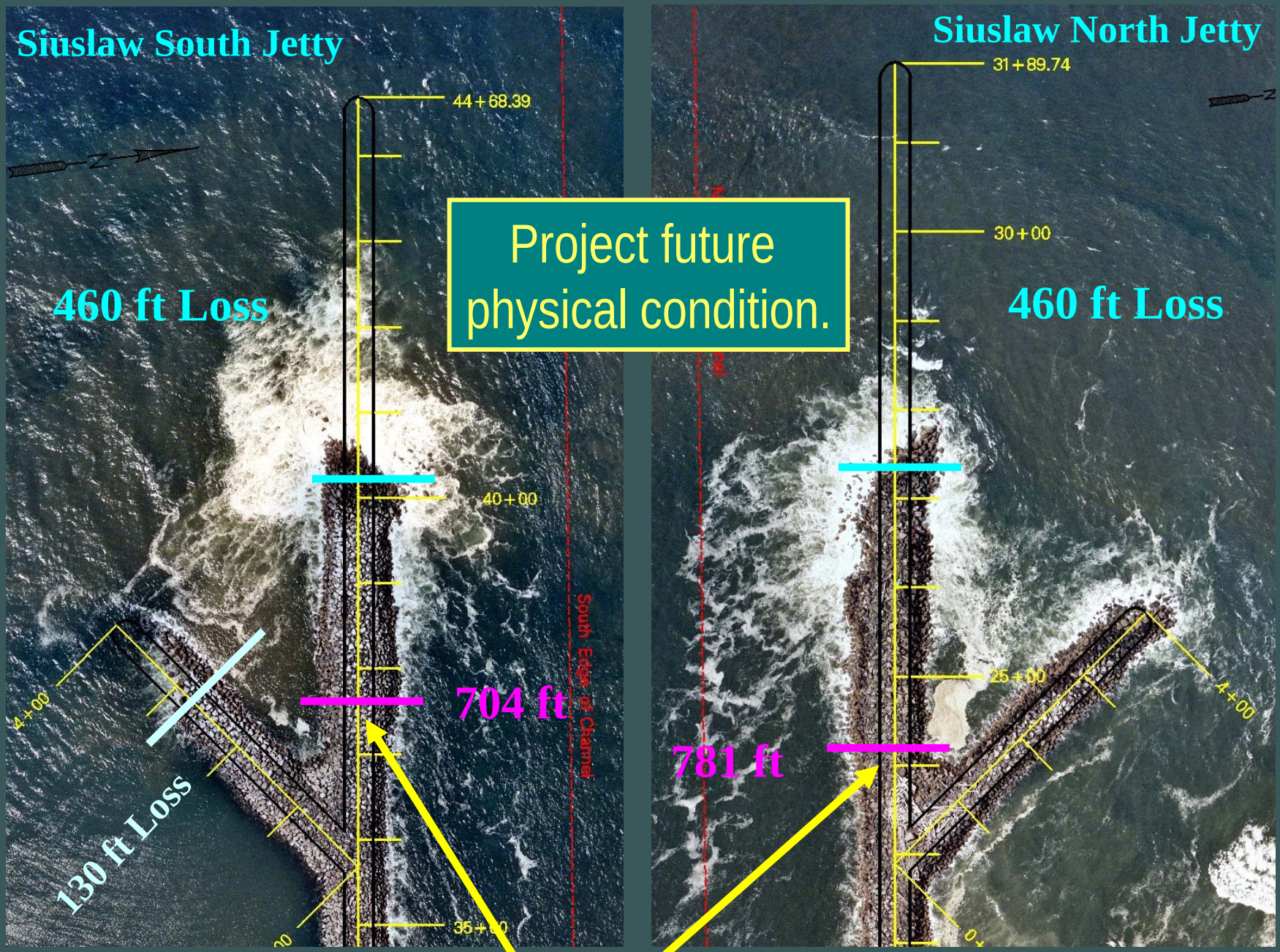
The ebb tidal shoal is receding at an accelerated rate between 1993 and 2000.



Keep track of shoreline evolution with respect to structure condition.

Understand Project Interrelationships and Apply Preventative Measures





Projected 2010 jetty head positions at current loss rates.

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Reporting Tools

- Yearly Inspection Reports
- Coastal Projects Matrix
- Critical Infrastructure Spreadsheet
- 5-Year O&M Plan
- Aerial and Oblique Photographs
- Economic and Usage Ranking of Projects

COASTAL NAVIGATION PROJECT STATUS - PORTLAND DISTRICT (USACE)

Project History | Structural Condition/Damage Area | Navigation Use of Project | Level of Concern

Coastal Navigation Project	Construction	Co	Ma	Lo Ma	Current Studies	Le	Je	Je	Je	Co	Re		Co P	Ch St	Cons of	Na Co	Dr Urgency Ranking
High Navigation Use Projects *(ordered by vessel volume within high use category)*																	
Columbia River Entrance																	
North Jetty (06/06) [9]	1913-1917	12,200'	2005	trunk	MR/CO	2061' [1]	Poor	Poor	Poor	High	High	High	All Year	High		High	1
South Jetty (06/06)	1885-1895	34,850'	2006-2007	trunk	MR/CO	6247' [2]	Poor	Poor	Fair	11299	100530	4642		High			
Jetty A (06/06)	1939	10,000'	1961	trunk/head	MR	886' [3]	Poor	Fair	Good					High			
Chetco Entrance																	
North Jetty (06/06)	1957-1958	1,300'	1969	450' ext.	-	0'	Fair	Good	Good	Med	High	Low	All Year	Low		Low	10
South Jetty (06/06)	1957-1959	1,570'	1996	root/trunk	-	10'	Fair	Good	Good	6743	39139	845		Low			
Harbor Breakwater (06/06)		1781'	2006	head	CO	-	Fair	Good	Good								
Yaquina Entrance																	
North Jetty (06/05)	1889-1896	7,000'	2001	head	MT	352' [4]	Good	Good	Good	High	Med	High	All Year	Med		High	
South Jetty (06/05)	1881-1896	8,600'	1972	1800' ext.	-	16'	Good	Good	Good	14394	8741	5282		Low			
Coos Bay Entrance																	
North Jetty (06/05)	1891-1898	9,600'	2002	root	EV/MT	1117' [5]	Poor	Fair	Poor	High	Med	Low	All Year	Med		High	3
South Jetty (06/05)	1924-1929	4,580'	1963-1964	all	-	328' [6]	Fair	Good	Good	11012	5739	1029		Med			
Tillamook Entrance																	
North Jetty (04/05)	1914-1918	5,700'	2004	root	MT	480'	Poor	Fair	Poor	Med	Med	Med	All Year	High		High	2
South Jetty (04/05)	1969-1979	8,000'	-	-		816'	Poor	Poor	Fair	5161	10141	2482		High			
Medium/Low Navigation Use Projects *(ordered by vessel volume within medium/low use category)*																	
Port Orford										Med	Low	Low	N/A				
Breakwater (06/06)	1968	550'	-	-	-	0'	Fair	Poor	Good	6932	772	18		High		High	4
Rogue River Entrance																	
North Jetty (06/06)	1960-1961	3,300'	1966	trunk	-	9'	Fair	Good	Fair	Low	Low	Med	Seasonal	Med		Low	8
South Jetty (06/06)	1959-1960	3,400'	-	-	-	0'	Poor	Poor	Fair	1843	476	3349		High			
Umpqua Entrance																	
North Jetty (06/05)	1917-1919	8,000'	1977	trunk/head	-	0'	Fair	Good	Good	Low	Low	Low	All Year	Med		Med	7
South Jetty (06/05)	1933-1934	4,200'	1963	all	-	176' [8]	Poor	Fair	Good	2978	4266	164		High			
Training Jetty (06/05)	1950-1951	6,100'	1978-1980	3144' ext.	-		-	Good	Fair					Med			
Siuslaw Entrance																	
North Jetty (06/05)	1892-1901	9,740'	1984-1985	1900' ext.	EV	464'	Poor	Fair	Good	Low	Low	Low	All Year	High		Med	5
South Jetty (06/05)	1910-1913	6,245'	1984-1985	2300' ext.	EV	419'	Poor	Good	Good	2199	639	466		High			
North Jetty Spur (06/05)	1984-1985	400'	1984-1985	-	EV	10'	Fair	Good	Good								
South Jetty Spur (06/05)	1984-1986	400'	1984-1985	-	EV	130'	Poor	Good	Good								
Coquille Entrance																	
North Jetty (06/06)	1892-1909	4,200'	1957	trunk	-	0	Good	Good	Good	Low	Low	Low	Seasonal	Low		Low	9
South Jetty (06/06)	1881-1901	2,700'	1954-1955	head	-	0'	Poor	Fair	Good	506	319	669		High			
Nehalem Entrance																	
North Jetty (93/05)	1916-1919	3,500'	1981-1982	all	-	<25'	Fair	Good	Good	Low	Low	N/A	N/A	Low		Low	11
South Jetty (93/05)	1910-1916	4,950'	1981-1982	all	-	<25'	Fair	Good	Good	66	930	0		Low			

Project History

Structure Condition

Navigation Use

Level of Concern

Rank

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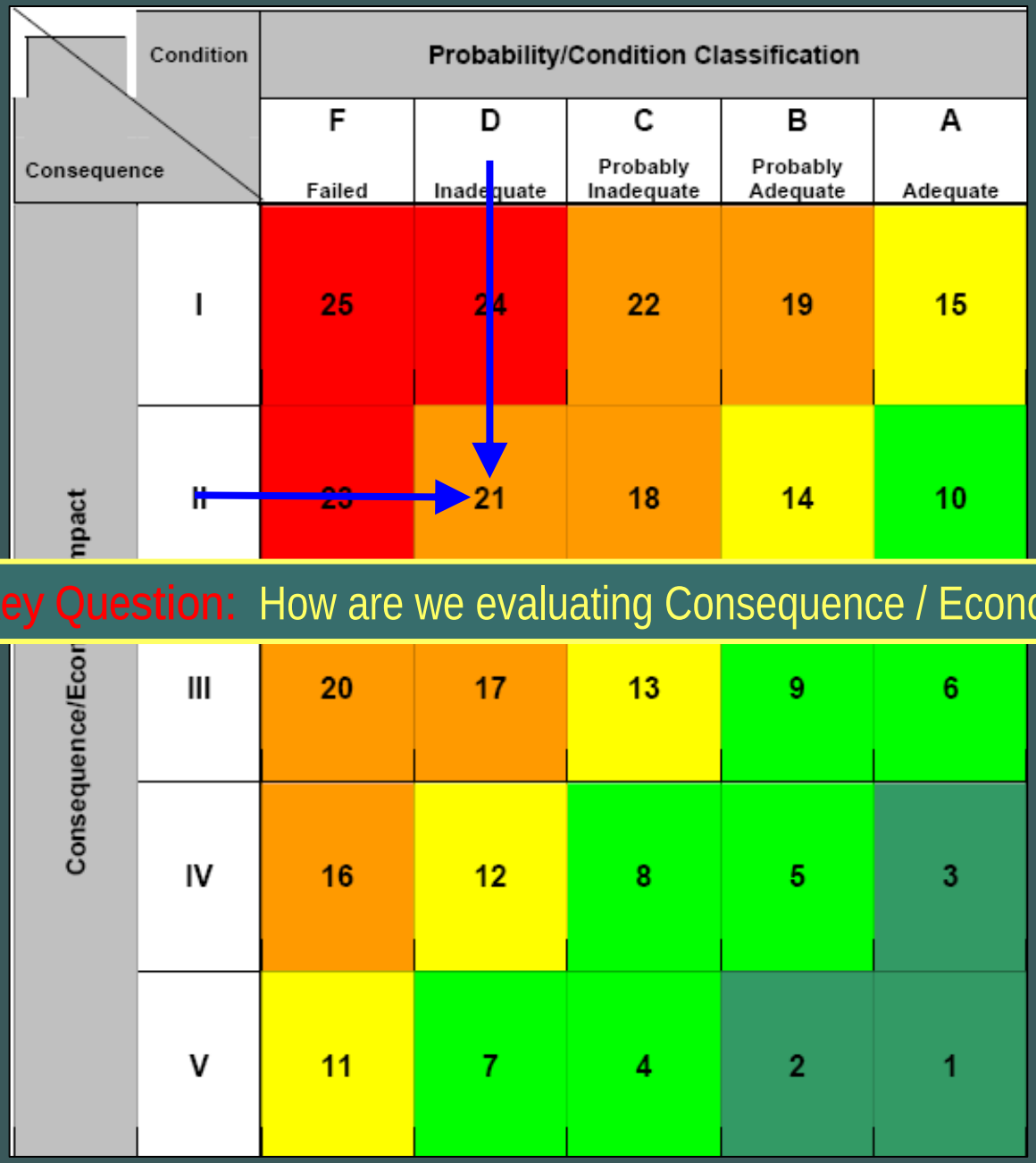
Critical Infrastructure Spreadsheet

- Developed every year for all district projects
- Intended to cull out projects with imminent failure and potential for significant impacts
- Uses general dam safety system guidelines
- Key input:
  - Frequency of threshold loading
  - Expected chance of failure given threshold loading
  - Estimated consequences of failure

New Navigation Relative Risk Ranking Matrix



Consequence / Condition	F Failed	D Inadequate	C Probably Inadequate	B Probably Adequate	A Adequate
I	25	24	22	19	15
II	23	21	18	14	10
III	20	17	13	9	6
IV	16	12	8	5	3
V	11	7	4	2	1

Probability/Condition Classification

Consequence/Economic Impact

Combines structure condition with projected consequences to provide ranking.

Key Question: How are we evaluating Consequence / Economic Impact for our projects?

- High Relative Risk
- Med-High Relative Risk
- Medium Relative Risk
- Low Relative Risk
- Minimal Relative Risk

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Available Information to Evaluate Project Ranking at Base Level

- Initial project investment
- Maintenance over project life; over past 25 years
- Deferred project maintenance
- Average annual waterborne commerce value
- Economic contribution of Ports to State
- Vessel usage of ports (commercial, recreational, charter)
- Coast Guard presence
- Potential for Loss of Life

Average Annual Waterborne Commerce Value of Oregon Ports : 1995-1998

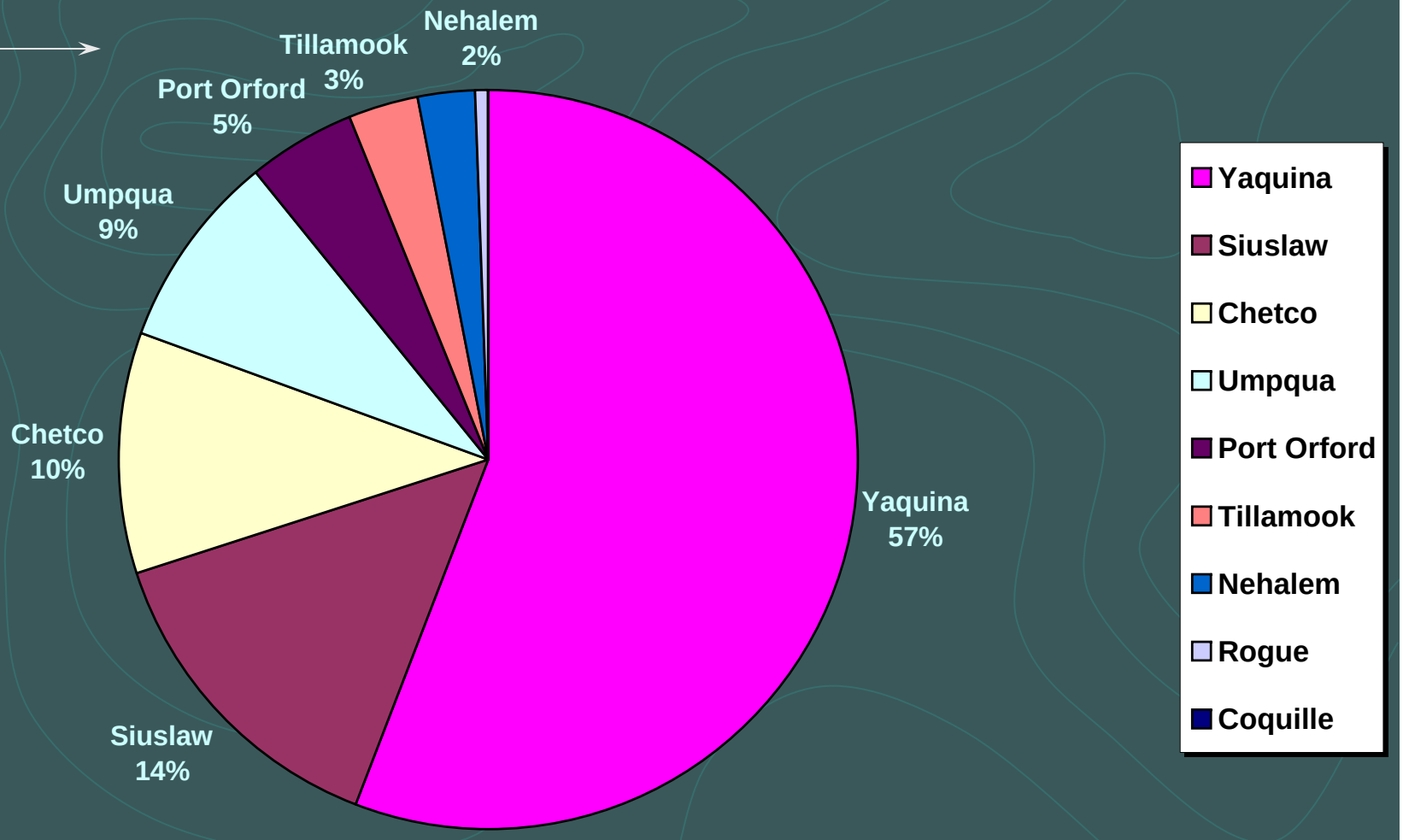
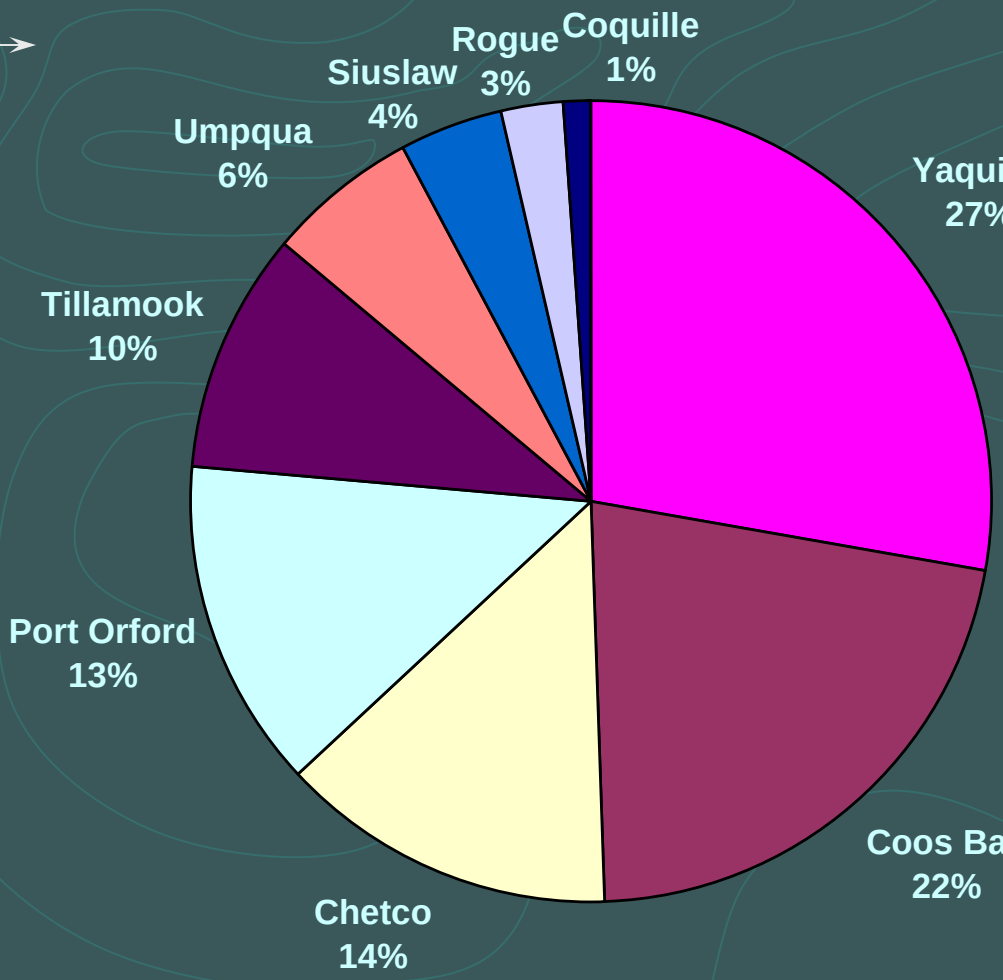


Chart is based on state total excluding MCR and Coos Bay

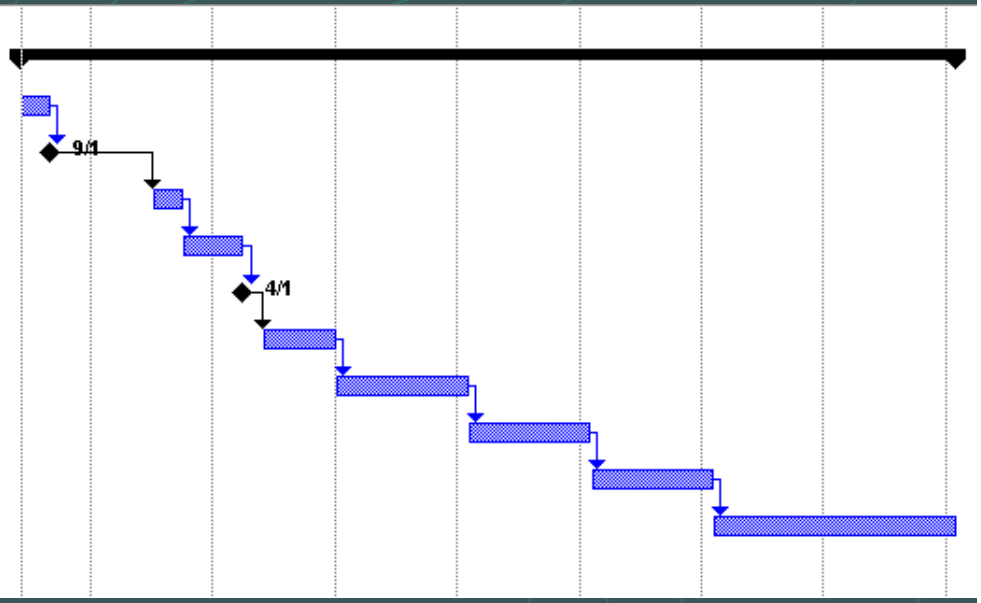
Commercial Vessel Usage of Oregon Coastal Ports: 1995-1998



Excludes MCR

How is Risk Affected by our Typical Timeline for Infrastructure Action?

Coastal Infrastructure Action	**Mon 6/2/08**	**Mon 2/1/16**
Routine Inspections	Mon 6/2/08	Fri 8/29/08
Problem Identification	Mon 9/1/08	Mon 9/1/08
Data Collection	Mon 7/6/09	Wed 9/30/09
Data/Project Evaluation	Thu 10/1/09	Wed 3/31/10
Decision to Repair	Thu 4/1/10	Thu 4/1/10
Numerical / Physical Modeling	Tue 6/1/10	Fri 12/31/10
Major Maintenance or Major Rehab	Mon 1/3/11	Tue 1/31/12
Detailed Design Report	Wed 2/1/12	Fri 2/1/13
Plans & Specifications	Mon 2/4/13	Mon 2/3/14
Construction	Tue 2/4/14	Mon 2/1/16



- Total timeline from Problem Identification to Construction Start estimated at 4 to 8 years. Assumes constant and timely funding at each level.
- Interruptions in funding stream can add 2 to 10 years to overall process.

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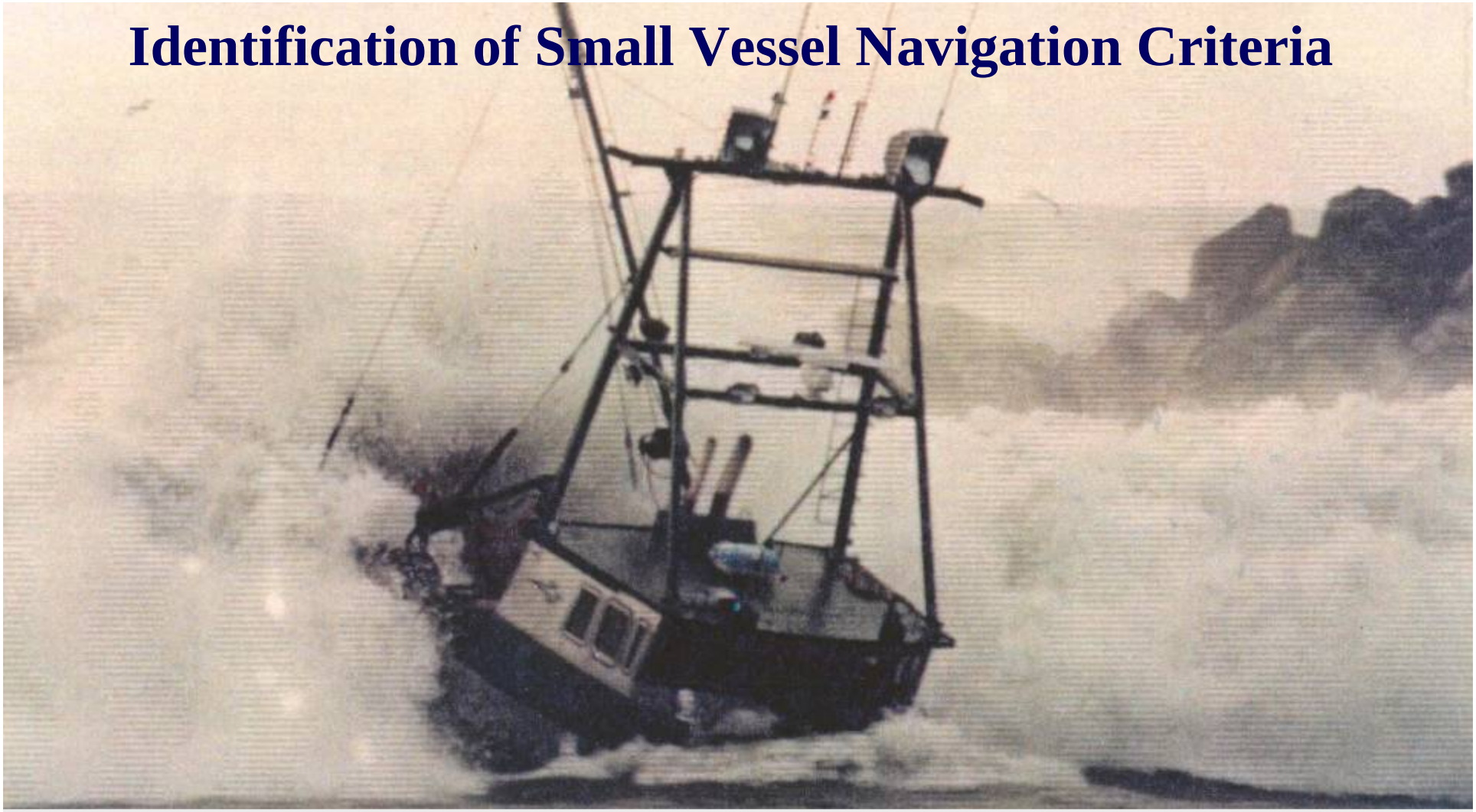
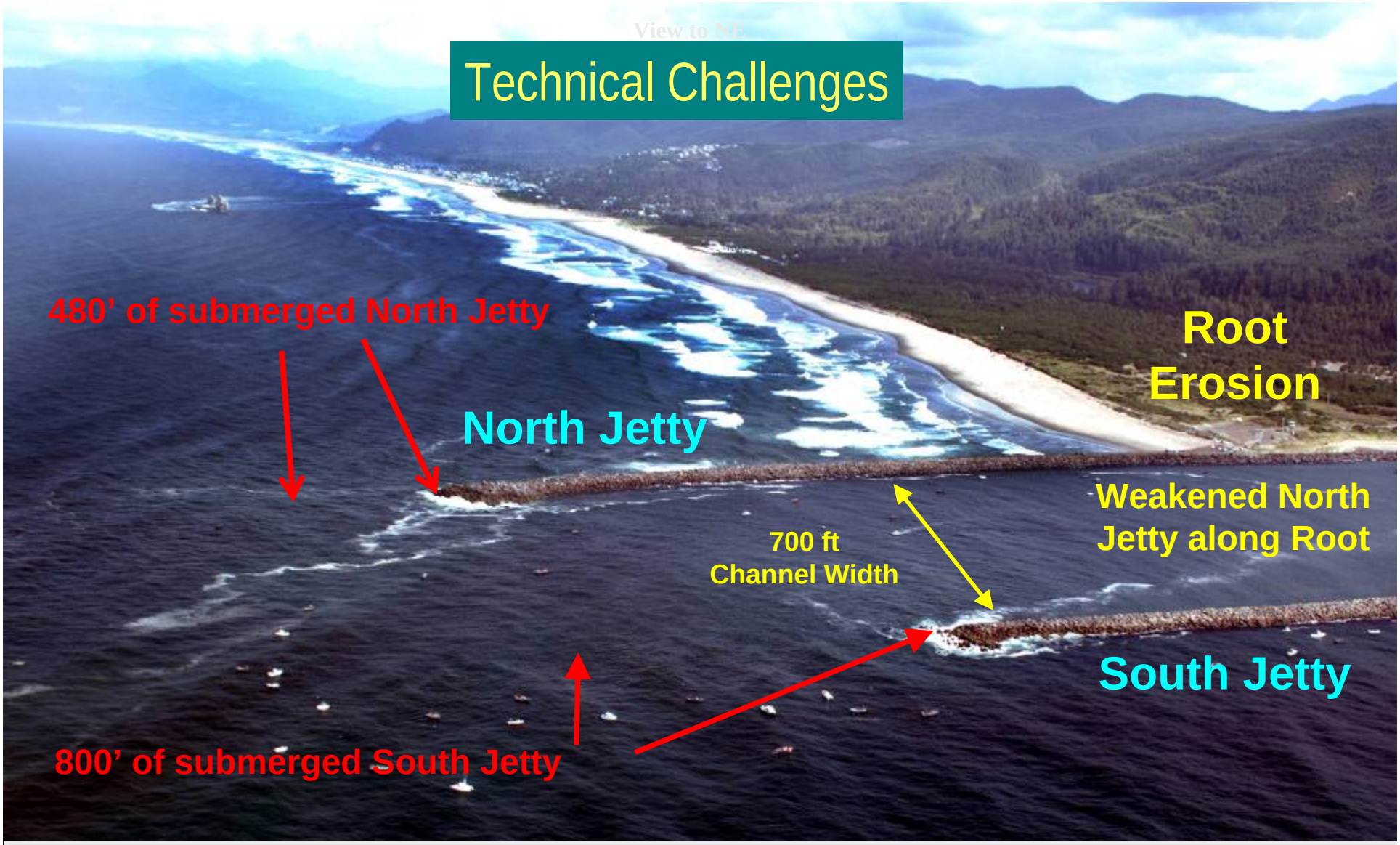
What can we do better?

Identification of Small Vessel Navigation Criteria



- We need to establish performance thresholds and design guidance for small vessel operation.
- Entrances are routinely used during winter months for commercial fishing activities and during storm events as harbors of refuge.
- Shallow-draft boats are typically small and are strongly influenced by wind waves and swell. Wave criteria for safe transit of entrance channels are more demanding than for deep-draft vessels.

Technical Challenges

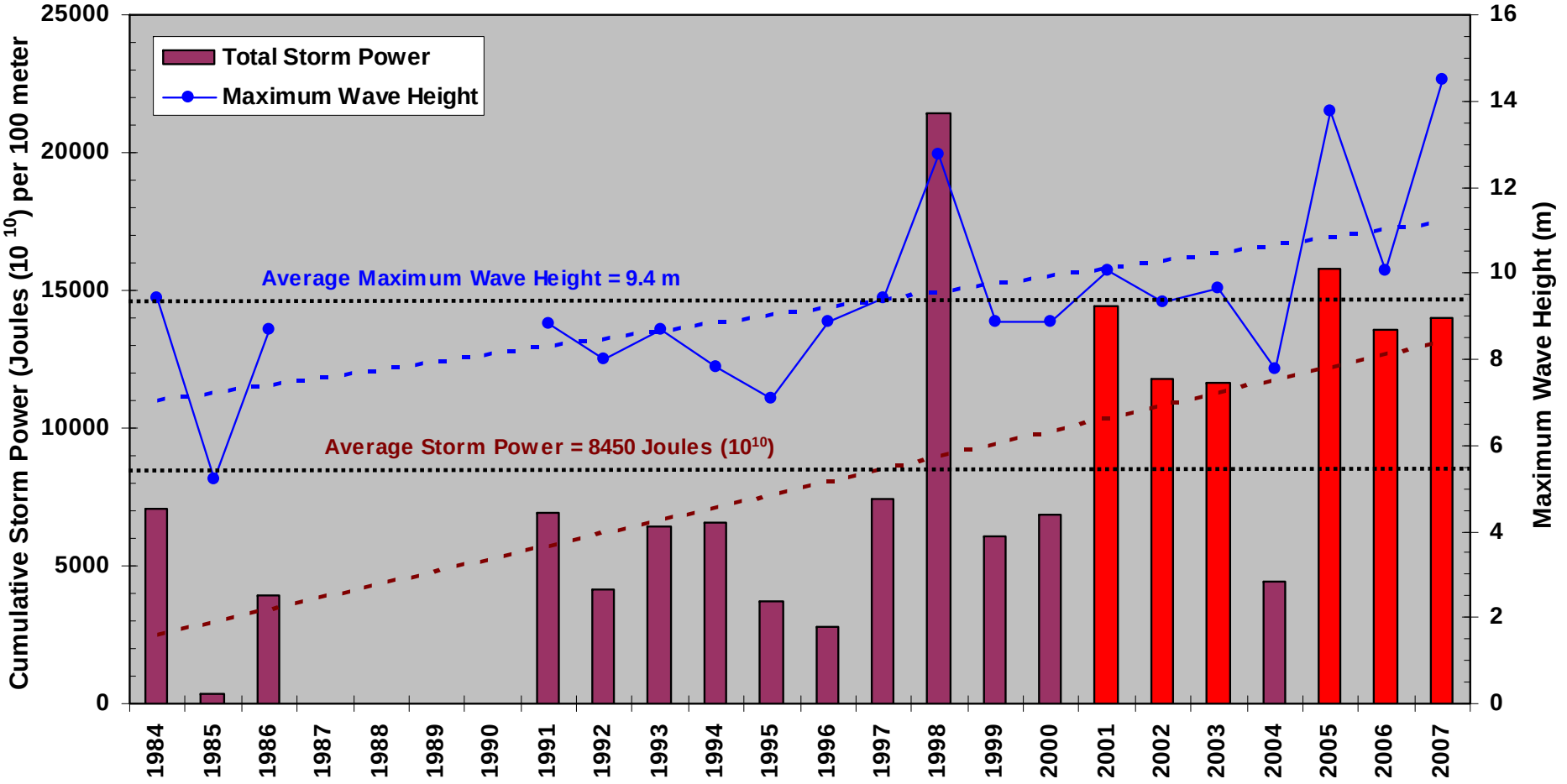


- Identify how deterioration or changed physical conditions at a project may impact project function.
- Define each project's limiting operating constraints to focus our action toward sustaining project function.
- At what jetty head loss are we impacting project function? Do submerged jetty heads impact navigation?

DRAFT

Storm Climate Intensity (1984 to 2008)

(Using Cumulative Storm Power and Maximum Wave Height)



- Quantify real increases to the forcing climate and include in risk assessment.
- Can we predict critical project failure by tracking individual and cumulative storm power?
- Explore potential design and reliability connections to storm power and infragravity surge.

- Improve reliability and progression of failure calculation of jetties for major rehabilitation studies.
- Explore the role of overtopping in structure destabilization and deterioration.
- Optimally utilize the various levels of repair available ranging from costly emergency repairs after a failure to low level interim repairs to more comprehensive major rehabilitation.

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Coastal Infrastructure Challenges

- Identify procedures that can minimize emergency action expenditures and minimize impacts to project function and/or loss of life situations.
- Given the challenging funding climate, how should the districts be defining necessary performance for deteriorated coastal navigation projects?
- Explore different levels of risk and consequence analysis as well as potential larger picture avenues toward cost-effectively maintaining our aging infrastructure.
- Actively seek improvements in design procedures, risk and reliability analyses.

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Creative Tools to Address Challenges

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Coastal / Navigation Structures Asset Management Advisory Board

Purpose: To target and improve COE coastal project asset management using a focused group of engaged local and national Corps experts.

Potential tasks to be considered:

- Inventory of Corps' coastal structures and current maintenance practices.
- Evaluate the dam safety approach for evaluation of coastal projects.
- Compare various risk and reliability methods for coastal structures.
- Evaluate methods to assess economic viability of projects.
- Consider pros and cons of regional approach to project maintenance.
- Build on the 2005 Pacifica Workshop and the 2008 Chicago workshop.

Methods Other Districts / Regions Use to Cost-Effectively Perform Maintenance on Multiple Projects

- The Great Lakes Districts utilize their own floating plant fleet (tugs, cranes, barges) to perform routine maintenance.
- Rock is pre-purchased and stockpiled for use on multiple projects.
- Indefinite delivery contracts are used for materials purchase.
- These districts utilize the fleet as a regional resource, and have a region level commitment to fund the base level of the program.
- Allows rapid response in emergency situations.
- Allows a methodical approach to contracts and materials purchasing.

Photos courtesy Paul Bijhouwer and Bruce Sanders of Buffalo District.

Pacific Ocean Field Research Center ?

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- Propose Oregon Coast as a “large-scale” field laboratory for rubblemound design optimization and exploration of Pacific Ocean processes.
- Opportunity to work proactively with local universities with excellent “smaller scale” lab facilities.
- Extreme environment test conditions representative of Pacific Ocean processes.
- Opportunity for multiple test sections incorporated into ongoing jetty repair projects.
- Testing “adaptive/movable” rubblemound structure.
- Can build on existing office facilities.

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Key Risk Management Questions

- How well do we understand the forcing environment? Can our approach incorporate increasing trends or changes?
- Do our design and reliability procedures adequately capture the potential range of the controlling processes?
- Do we understand the project function and the level of risk associated with non-action or non-performance?
- How are we prioritizing infrastructure work and what tools are we using to evaluate and communicate risk?
- Are we fully utilizing all available tools to optimize repairs and minimize costs? Are we planning for long-term sustainability?

Innovative and Environmentally-Friendly Armor Unit

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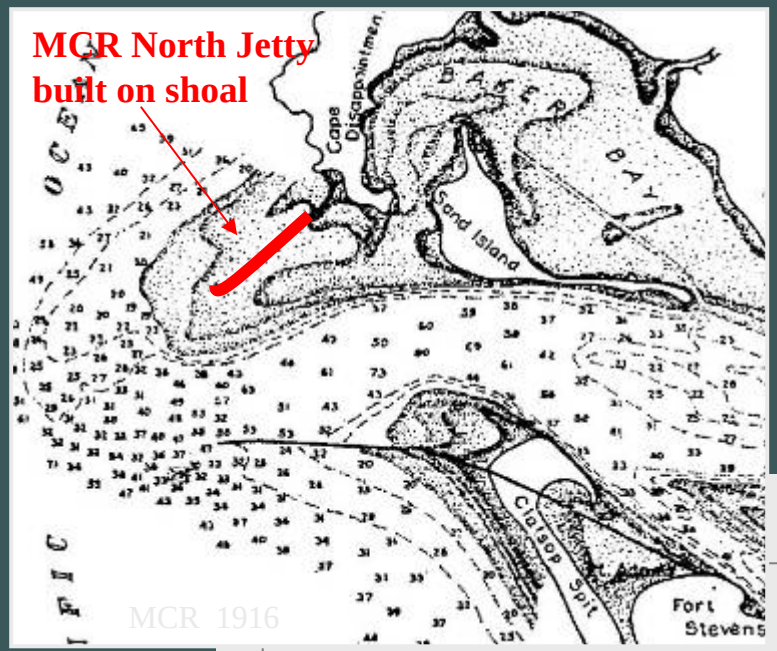
5-Year O&M Plan

- **Monitoring:** Routine monitoring to assess structural and functional performance of project
- **Data Collection:** Structural and hydrographic survey data collection to identify degree of identified problem.
- **Data Assessment and/or Modeling:** Preliminary study to assess functional impacts of problem and budget needs.
- **MMR or MRR:** Design report which quantifies degree and extent of repair and recommended plan.
- **P&S:** Document which leads into repair construction.
- **Interim Repair Construction:** An out-of-cycle repair that requires an accelerated track due to potential impacts.
- **Construction:** Planned for repair construction.

Critical Infrastructure Spreadsheet
(Uses Dam Safety Risk Guidelines)

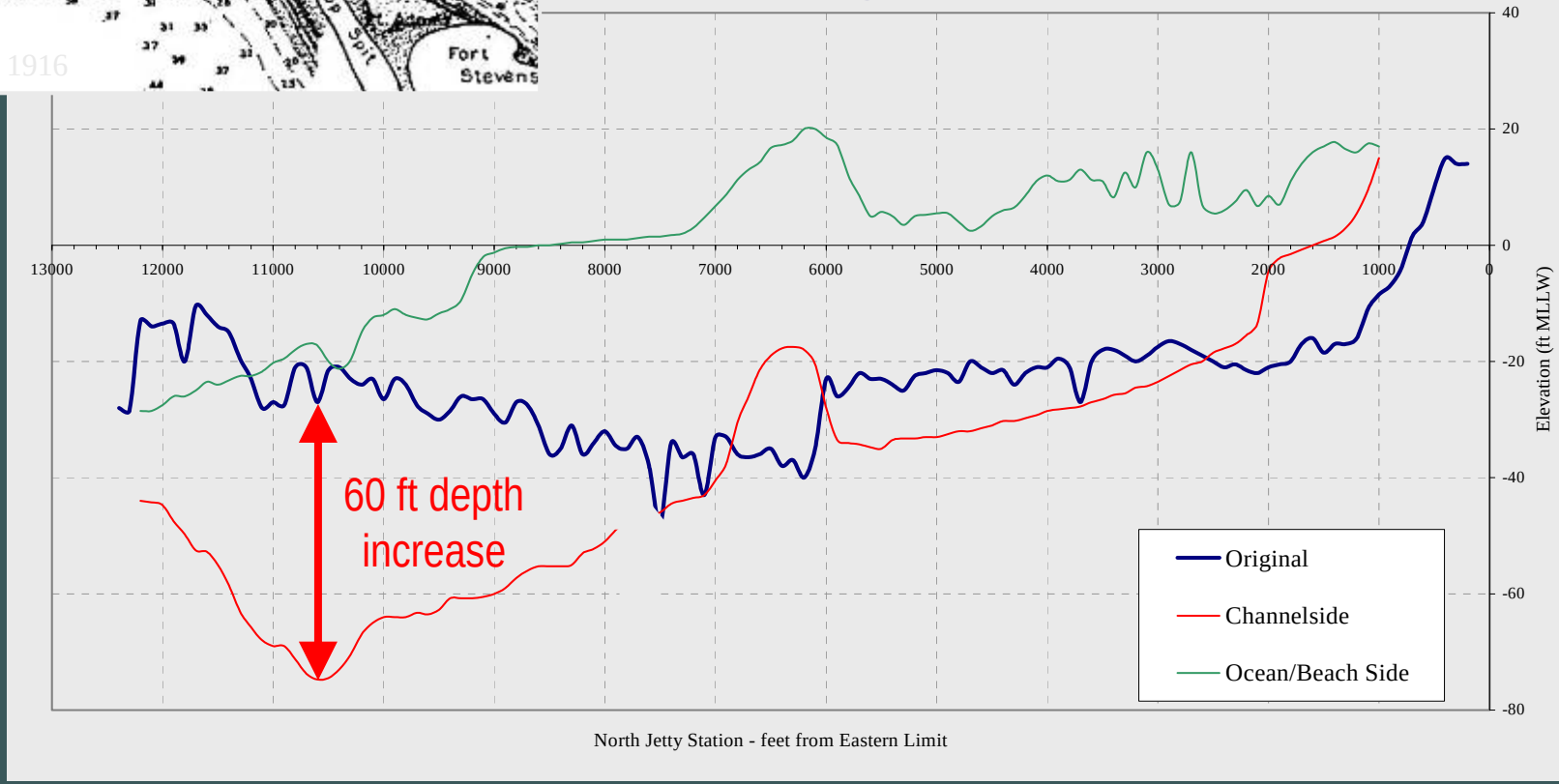
Business Line	Ranking		Project	Feature	Phase	Description of Unsatisfactory Performance	Annual Frequency of Loading	Conditional Probability of Unsatisfactory Performance	Annual Probability of Unsatisfactory Performance	Consequences of the Unsatisfactory Performance	Matrix Ranking Value
	District Rank	Focus Area Rank									
Navigation		1	Mouth of the Columbia River	South Jetty Ocean Reach B Sta. 258 to 230 3200 ft	Repairs	Potential breach (20% probability, 5-year wave)	Very Often	Very High	Very Likely	Catastrophic - rapid sediment infill of navigation channel, serious impacts to navigation, economic impacts to ports/commerce, rapid deterioration of jetty, increased jetty repair and dredge costs	1.0
Navigation		2	Coos Bay	North Jetty Root Sta. 45 to 47 200 ft	P&S / Repair	Ocean shoreline and north jetty root would be breached. Ocean flow would flank north jetty.	Very Often	Very High	Very Likely	Catastrophic - rapid sediment infill of navigation channel, serious impacts to navigation, economic impacts to port/commerce, rapid deterioration of jetty, increased jetty repair and dredge costs	1.0
Navigation		3	Mouth of the Columbia River	North Jetty South Jetty Jetty A	Major Rehab Rpt	Continued deterioration and failure of primary navigation structures.	Very Often	Very High	Very Likely	Catastrophic - rapid sediment infill of navigation channel, serious impacts/safety to navigation, economic impacts to ports/commerce, rapid deterioration of jetty, increased jetty repair and dredge costs	1.0
Navigation		4	Mouth of the Columbia River	South Jetty Root Sta. 160 to 185 2500 ft	Major Rehab Rpt	Potential for breach of weakened jetty root resulting in rapid structural deterioration and loss of land mass behind jetty root.	Very Often	Very High	Very Likely	Critical - sediment infill of navigation channel, rapid deterioration of jetty, increased jetty repair and dredge costs, increased loss of shoreline at vulnerable jetty root.	3.0
Navigation		5	Mouth of the Columbia River	North Jetty Trunk Sta. 86 to 92 600 ft	Major Rehab Rpt	Potential for breach of weakened jetty trunk resulting in rapid structural deterioration and sediment flow through jetty breach.	Very Often	Very High	Very Likely	Critical - sediment infill of navigation channel, rapid deterioration of jetty, increased jetty repair and dredge costs, increased loss of shoreline at vulnerable jetty root.	3.0
Navigation		6	Mouth of the Columbia River	North Jetty Cap 100 ft	Major Rehab Rpt						3.0
Navigation		7	Coos Bay	North Jetty	Major Maint. Rpt						3.0
Navigation		8	Coos Bay	North Jetty Cap 100 ft	Major Maint. Rpt						3.0
Navigation		9	Mouth of the Columbia	North Jetty Root Sta. 40 to 55	Major Rehab Rpt	Potential for breach of weakened jetty root resulting in rapid structural	Very Often	High	Likely	Critical - rapid sediment infill of navigation channel, rapid deterioration of jetty, increased jetty	5.0

Description of Unsatisfactory Performance
Annual Frequency of Loading
Probability of Unsatisfactory Performance
Annual Probability of Unsatisfactory Performance
Consequences of Unsatisfactory Performance

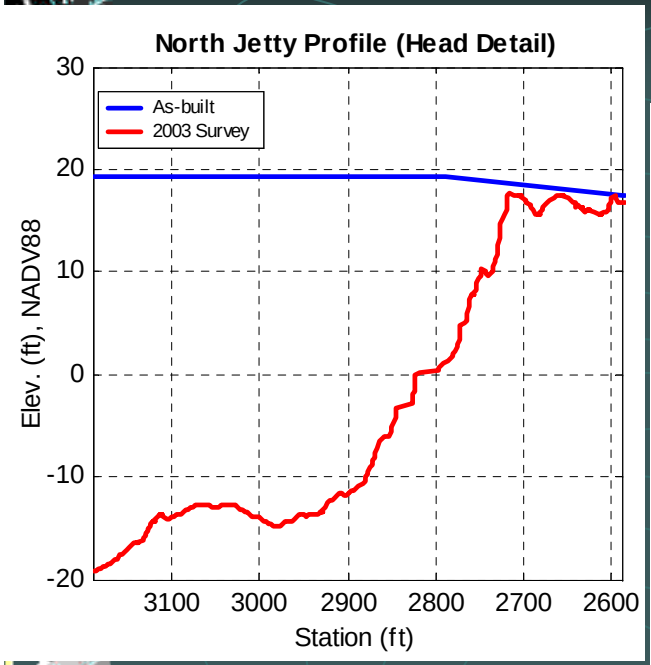


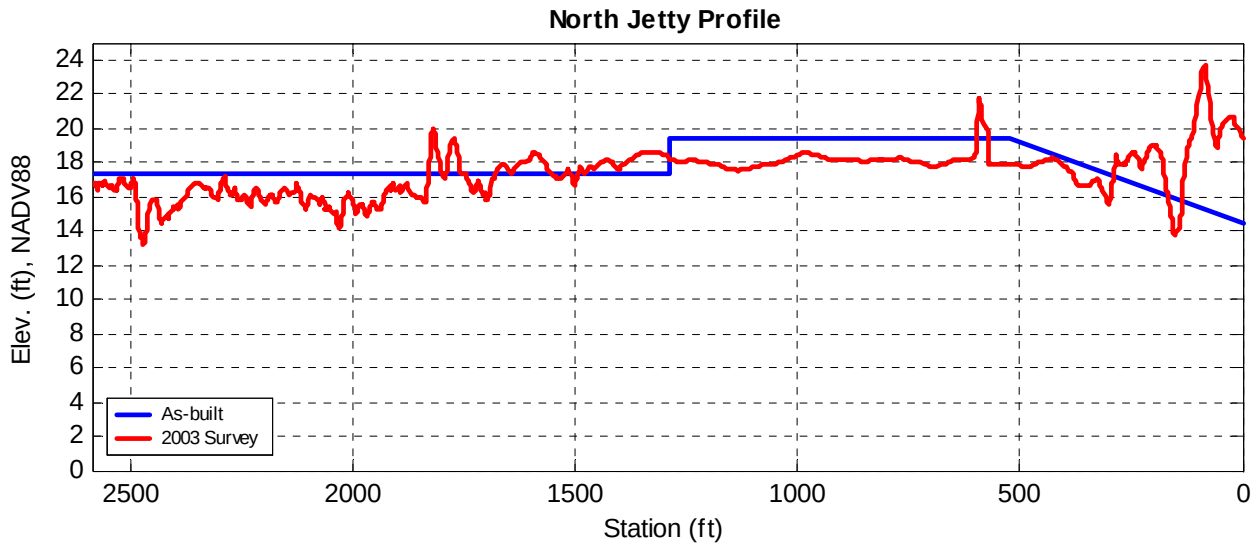
- Correlate morphology change to infrastructure longevity.
- Most of the jetties were built on shoals, as the shoals erode, the jetty foundations become affected, larger waves impact the structure.
- Identify regional sediment management opportunities to reduce structure maintenance and stabilize shorelines.

Profile along North Jetty Toe



Profile and cross section comparison to original design.





Major damages

Minor to moderate damages